En Route Severe Weather

EW-1 Provide Better Hazardous Weather Data

The disruptions caused by hazardous en route weather are magnified by the uncertainty in the location, movement, and severity of the weather conditions. Forecast accuracy is not well suited to the strategic planning of traffic flow decisions. Joint planning is further hindered by limitations in real-time data sharing capabilities. Operational decision making by airlines and traffic flow managers will be improved based on common awareness of the situation, coupled with the improved data exchange, training, and coordination processes which are being applied to the overall en route congestion problem.

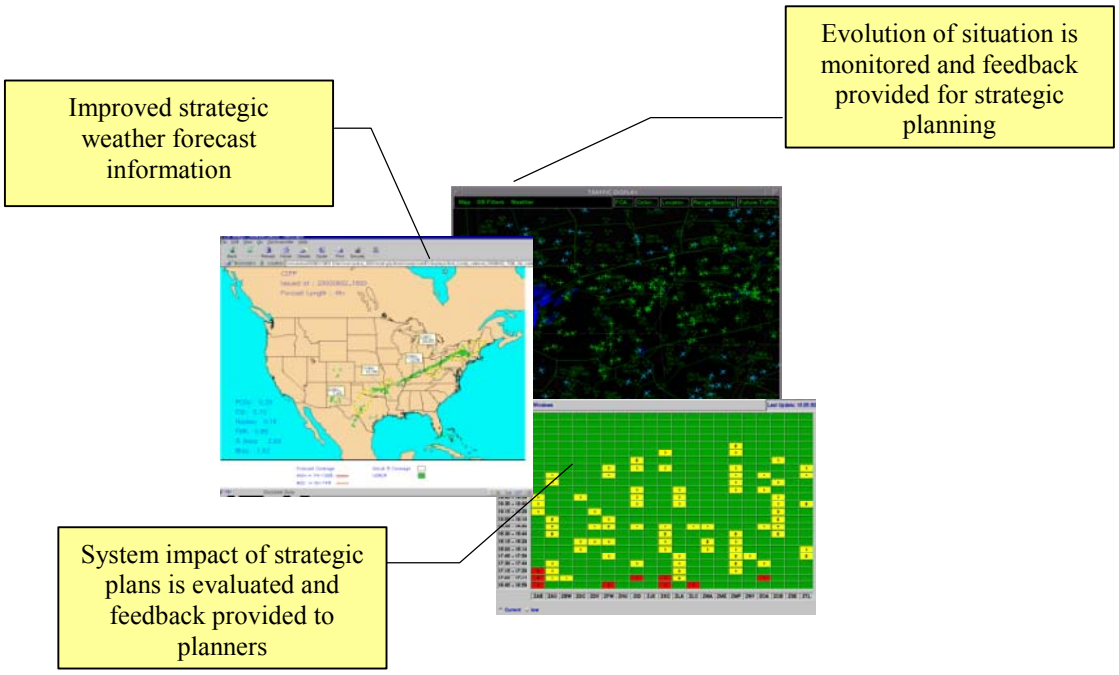
Key Dates

Improvements to FEA/FCA	2002
Decision on Need for Additional Weather Sensors and Radar Facilities	2002
Deploy On-DSR Weather Display	2003
Deployment of Improved Systems for Common Situational Awareness	2003
Deploy Additional CRCT/FCA Capabilities	2003

EW-1 Solution Set

EW-1: Provide Better Hazardous Weather Data

Improved predictability in convective weather forecast products with respect to growth, decay, movement, intensity, and coverage of thunderstorm activity, which will lead to a more efficient operational response to the weather condition.



Background

Problems generated by en route hazardous weather involve uncertainties due to changes in National Airspace System (NAS) capacity and the often-unpredictable nature of convective weather. The convective weather forecast prediction accuracy is not well suited to the strategic planning time frame of traffic flow decisions. In addition, lack of forecast fidelity with respect to timing makes impacted flight identification difficult at best, leading to the belief by many that areas forecast to have convective activity, regardless of probability, need to be treated as "no fly zones" for the planning process. Additional difficulties arise from limited real-time, data sharing capabilities.

Ops Change Description

Improvements will be evolutionary and will span the near, mid, and long term timeframes. The key operational change is improving NAS predictability as a by-product of a high confidence level in the accuracy of convective weather forecasts. Operational change will be highly dependent on the state-of-the art science and research of forecasting convective weather growth, decay, movement, intensity, and coverage. Therefore, operational change with respect to common situational awareness, common data exchange, and operational significance of current forecast products (e.g., an understanding that the Collaborative Convective Forecast Product (CCFP) is for guidance and not for required compliance) should be improved through a focus on training and the strategic planning process (identified in smart sheet ER-2) while work continues on improving convective weather forecasting. The following sections address the operational changes described:

- EW-1.1: Improved weather reporting and forecasting.
- EW-1.2: Dissemination of common weather information.

- EW-1.3: More precise identification of flights to be impacted by severe weather.
- EW-1.4: Display detailed weather to controllers.

Benefit, Performance and Metrics

As a result of the Summer 2001 operational experience using the CCFP, a number of evaluation studies have been launched. Since the data-gathering period was concluded (10/31/01), only a few preliminary impressions are available. Several reports (FSL; AvMet; and Metron) will be available by 2/02. Anticipating these evaluations, a list of improvements for CCFP in 2002 has been compiled and is under evaluation.

Other observations and tools have been implemented: Runway Visual Range (RVR), the Flow Constrained Area (FCA) tool, and the Collaborative Routing Coordination Tool (CRCT). Evaluation of these tools for their impact on Traffic Flow Management (TFM) is underway.

- Reduction in variance of execution against plan.
- Reduction in number and/or duration of ground delay programs in support of SWAP for en-route hazardous weather constraints.
- Reduction in the number and/or duration of ground stops due to hazardous en-route weather constraints. Reduction in fuel diversions due to hazardous weather encountered.
- Increased equity plus better plans equals an increase in system access/equity. This equity is achieved from narrowing the confidence gap that exists today from one system user to another or one FAA facility to another. Measurement of system access and area throughput along with analyzing user acceptance of the plan will determine forecast confidence.

EW-1.1 Improved Weather Reporting and Forecasting

Scope and Applicability

Improvements in the collaboration, issuance times, and operational applications of weather forecasts were implemented and studied as part of the 2001 convective weather season. Updates based on these findings and other weather research will lead to field trials in the coming years.

Currently, improvements in weather products are categorized into 3 components corresponding to Aviation Weather Research Program (AWRP) product development; Collaborative Decision Making (CDM)-CCFP development; and the TDWR products of Integrated Terminal Weather System (ITWS) and Corridor Integrated Weather System (CIWS). The cornerstone(s) for evaluating the experience during the Summer 2001 season lies correspondingly with the Aviation Weather Technology Transfer (AWTT) Board; the CDM Collaborative Routing (CR) Committee; and Lincoln Laboratory. Each of these organizations is reviewing the experience of the past convective season and will use these results for Summer 2002.

Near-Term:

- The CCFP is a collaborative product, developed by the Aviation Weather Center (AWC), Center Weather Service Units (CWSU), and Airline meteorological departments. A list of improvements to CCFP has been compiled and reviewed by an ad hoc committee under ARS-100. Subsequent review by the CDM-Collaborative Routing Committee will occur (12/01) for consideration of upgrades that are possible for Summer 2002.
- Corridor Integrated Weather System, CIWS will be evaluated during operations in the 2002 weather season. This product will focus on short-term weather on the timescales less than 1 hour within the corridor of heaviest air traffic between the Atlantic coast and Chicago. The CIWS employs TCWF technology to integrate weather and radar observations and produce forecasts of convective weather hazards out to an hour within the corridor region. This product is more detailed than the national products (NCWF and Convective SIGMETS), but with a wider scope than an individual radar site (ITWS). Lincoln Laboratory has the responsibility for evaluation.
- The NWS and the FAA accepted the National Convective Weather Forecast (NCWF) for short-term forecasts of thunderstorms for operational use (4/2001). The product will be deployed on TMS for display at FAA operational centers by 10/01.
- The AWTT process led by ARS-100 has evaluated in-flight Icing Products. The Integrated Icing Diagnostic Algorithm (IIDA) will be considered for operational implementation (12/01).
- Model Development of the Rapid Update Cycle (RUC) model.

Mid--Term/Long-Term:

- The FAA Aviation Weather Research Program (AWRP) has the lead for improved weather products and forecasting capabilities. Development of early and more precise identification of hazardous weather, to flights in the en-route environment, will lead to improved strategic planning and tactical applications of route management.
    - The Aviation Weather Technology Transfer (AWTT) Board has reviewed new products (4/01; 12/01) and established a mechanism for encouraging the transfer of research products into operational application.
    - The National Research Council has been commissioned to review the prospects for extending the capability of forecasting convective thunderstorms, and a report will be available in 2002.
- Current AWRP product team research that applies to the en-route environment include:
    - Aviation Forecasts and Quality Assessment (AFOA)
        - Products: Aviation Digital Data Service (ADDS) is the primary Internet platform for AWRP products and has received widespread acceptance from the pilot community.

- **Real Time Verification System (RTVS) is the tools and database for the ongoing evaluation of new products; e.g., NCWF; CCFP: IIDA.**

- Terminal Icing

  - A research project (RIDS, Radar Icing Detection System) is underway that would remotely detect hazardous icing conditions aloft using a network of surface-based, polarized radars.

– Model Development and Enhancement

  - The Rapid Update Cycle model is the basis for improved aviation forecasts, as well as for algorithms to detect hazardous flight conditions; e.g., IIFA icing forecasts. The high resolution RUC-20 version (20 Km horizontal resolution) in going through the final implementation stage and will go operational in 2/02
  - The Weather Research and Forecasting (WRF) model is under development with contributions from experts at more than 4 national centers and universities. This next-generation model will bring radical improvements in vertical and horizontal resolution, as well as improved forecasts of aviation variables. A workshop was held (8/01) to collaborate on model development that will build for operational deployment in FY05.

– NEXRAD Enhancements

  - Products: Rapid Product Update will bring improvements to the output from the existing NEXRAD network. The Joint Polarization Experiment is a field test of polarization capabilities that will be conducted in 5/02.
  - Convective Growth and Decay.
  - **Mesocyclone Detection.**

– Convective Weather

  - The Terminal Convective Weather Forecast (TCWF) is the basis for ITWS (terminal) and CIWS (enroute) products. These tools are being implemented in the Short Term.
  - The National Convective Weather Forecast (NCWF) also utilizes a version of TCWF technology and is now undergoing operational implementation in the Short-Term.

The Corridor Integrated Weather System (CWIS) will be the basis of a field study (THunderstorm Operations Research; THOR) that will include the participation of other short-term convective weather forecasting methodologies; i.e., NCWF and a similar NWS forecasting product- 3/02. The incorporation of satellite data into convective forecasting algorithms will be addressed by 8/02.

- Turbulence

  - Products: Turbulence Forecasting Integrated Turbulence Forecast Algorithm (TCWF) continues as a research objective.

    - Turbulence Observation In-Situ Measurement and Reporting
- Integrated ground based and/or airborne sensor/system improvements applied to weather products and decision support systems (DSS). Candidate sensor and system applications include:
  - Operational and Supportability Improvement System (OASIS).
  - ASOS Controller Equipment – Information Display System (ACE-IDS).
  - Stand Alone Weather Sensor (SAWS).
  - Automated Weather Sensor System (AWSS).

Key Decisions

- Installation of sensors or radar facilities as appropriate, including environmental impact studies.
- Increase adoption of user Pilot Reports programs (e.g., Northwest and United Airlines turbulence information programs).

Key Risks

- Funding of AWRP programs.
- Community roadblocks to radar or sensor installations.
- Operational implementation and significance of the anticipated improvements in TFM as a result of improvements made to convective weather forecasts.
- Speed of the research and development of weather sciences.
- National Weather Service cost/benefit analysis for producing additional aviation weather products and systems.
- A satisfactory assessment by the three organizations responsible for weather product evaluation: the AWTT Board; the CDM-CR Committee; and Lincoln Laboratory, including follow-up for operational implementation.
- Cost/benefit analysis for outfitting aircraft with additional weather sensing equipment.

EW-1.2 Dissemination of Common Weather Information

Scope and Applicability

Near-Term:

There were several improvements in information dissemination:

- Improvements in the CCFP dissemination and access based on recommendations from Spring/Summer 2000 review from the broadest range of stakeholders. The focus on this effort is to ensure the CCFP is available on the ATCSCC web site and the Aviation Weather Center (AWC) web site. Furthermore, the CCFP will become available on the TMS at FAA centers after 10/01.

- The National Convective Weather Forecast (NCWF) will be distributed on the TMS after Fall 2002
- Runway Visual Range (RVR) information is currently being provided to users via the CDMNet for 42 airports.
- Identify policies, procedures, and issues that are barriers to exchange of weather information.

Mid- and Long-Term:

- Weather information use and dissemination that can be used to support strategic planning for TFM and built into TFM tools.
- An Operations Concept (Conops) for the operational use of weather information and forecasts needs to be written for the TMUs at the local, regional, and national level. This Conops would incorporate the use of new systems: WARP, ITWS, CIWS, and emerging weather tools: for weather hazards; e.g., CCFP, NCWF, IIDA. Subsequently, standards and procedures will follow.

Key Decisions

- Weather research funding.
- Infrastructure needed for the dissemination of weather products and for system access (e.g., web access policies and/or exploration of other means of general distribution of community use weather products).

Key Risks

- Speed of improvements in the state-of-the-art of weather science.

EW-1.3 More Precise Identification of Flights to be Impacted by Severe Weather

Scope and Applicability

Near-Term:

- Flow Constrained Area (FCA) tool was deployed (phase 1) on 6/18/01. (Ref: ER-2.1) Additional CRCT capability will be implemented in ETMS. FCA's provide identification of specific flights that will be affected by severe weather for more targeted resolutions.
- A committee is considering policies, procedures, and practices that identify and disseminate lists of affected flights using FCA capabilities. The committee will also reach resolution on actions to be taken.
- A tool to provide Traffic Management Specialist capabilities to assess the impact of proposed flow management strategies on NAS flows.
- DSP assigns a departure time to achieve a constant flow of traffic over a common point. Runway and departure procedures must be considered for accurate projections.

Mid-Term:

- Additional flight filtering and CRCT re-route functionality will be implemented in ETMS.
- Automation development for communication flight plan changes quickly.
- Information to produce solutions to airspace capacity and en route weather constraint problems.

Key Decisions

- Early intent filings (e.g., proposed four hours prior to departure) by the NAS users, to enhance ETMS data quality, for improved flight identification and predictability.
- Define collaborative processes and procedures for using FCA capabilities in ETMS.

Key Risks

- Speed of the research and development of weather sciences.

EW-1.4 Display Detailed Weather to Controllers

Scope and Applicability

Mid-Term:

- Development of policies and procedures prior to implementation of NEXRAD weather display on DSR. Policies and procedures have been reviewed for all labor-management issues, and agreement reached. MOUs signed by PASS (8/01), and NATCA (10/01)
- Full deployment of NEXRAD weather-on-controller-display (DSR) requirements (e.g., procedural changes) to ensure controller has accurate weather information from which to identify potential impact areas. The WARP communications and display is now implemented in all ARTCCs and the ATCSCC so that weather data is available to all TMUs and on the Briefing Terminals for TFM Specialists. All software formatting required for WARP-to-DSR terminals have been accomplished.
    - Operational test and evaluation at DFW by Jan 02
    - Repeat OT and E at JAX by Apr 02
    - National implementation in the second half of CY02.
- AWRP is developing actions and milestones to achieve the objective for the mid term to long-term: Rapid update of "point products" (hazards); new radar volume coverage to decrease the time of radar refresh rate. This work is ongoing.

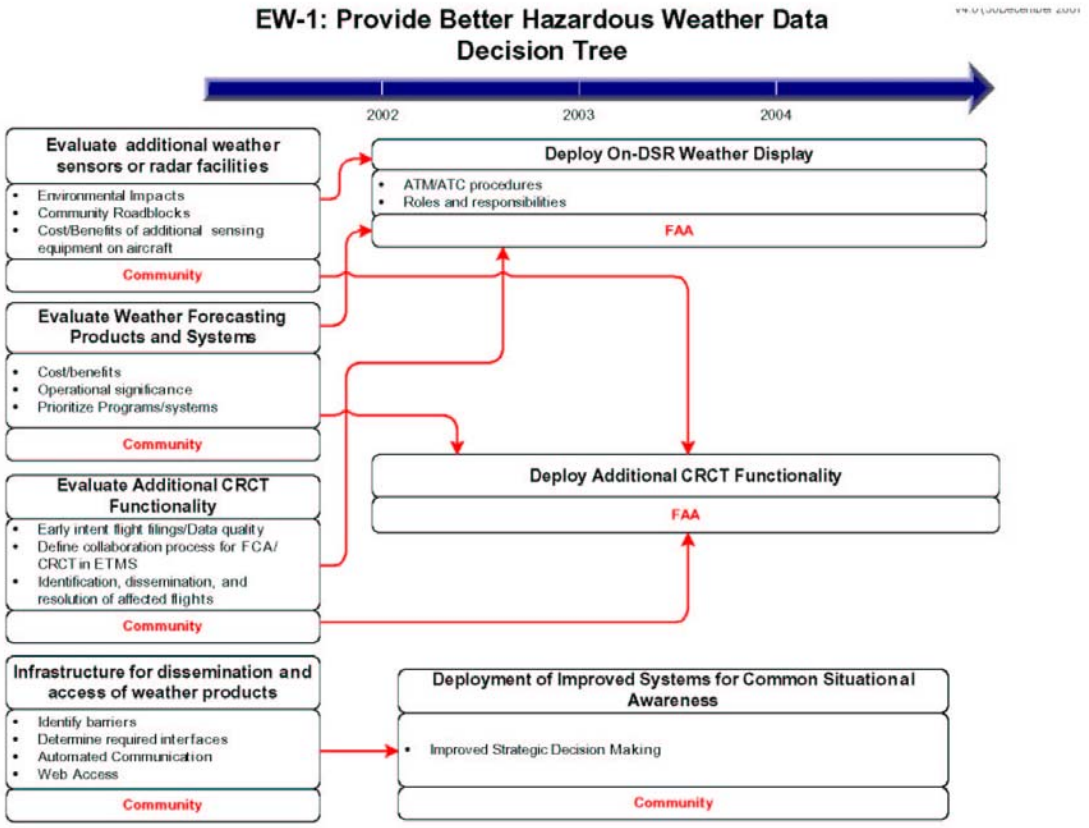
Key Decisions

- Roles and responsibilities with respect to hazardous weather avoidance (NATCA, TWU, ADF, ALPA, APA, NBAA, RAA).

Key Risks

- Agreement on roles, responsibilities, and accountability issues.
- Deployment of required interfaces (e.g., WARP/DSR) is complex process and may induce schedule delays and additional requirements (e.g., security).

EW-1 Decision Tree



EW-1 Responsible Team

Primary Office of Delivery
Jack Kies, ATT-1

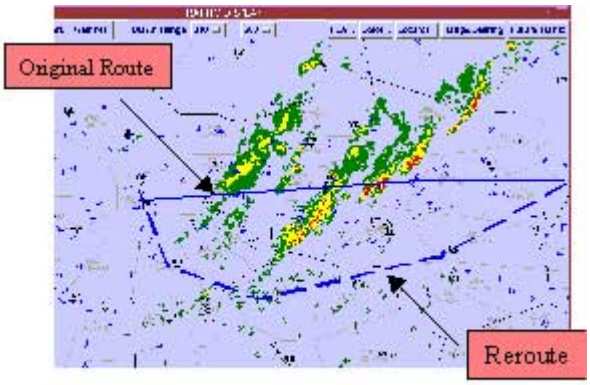
Support Offices
ATP-1
AUA-100
AUA-200
AOZ-1
AUA-700
ARU-1

EW-1 Links To Architecture

Air Traffic Services / ATC-Advisory / Weather Advisories Capability
103107 - Current Convective Weather Advisory - En Route
103109 - Improved Weather Gridded Forecasts - e.g. Icing
103111 - Common En Route and Terminal Weather Situational Awareness

Air Traffic Services / TM-Strategic Flow / Flight Day Management
105201 - Current Flight Day Management
105204 - Collaborative Rerouting (CRCT Demonstration)

EW-2 Respond Effectively to Hazardous Weather



En Route

Managing the routes of aircraft, and particularly adjusting routes quickly to avoid hazardous weather conditions without disruptions to traffic flows, is difficult in today's environment. This leads to inefficient use of available airspace and unnecessary congestion and delays. Some sources of the difficulty are: rigid airspace and route structures; incompatibilities among automation systems used by airlines, aircraft flight management systems, and air traffic management; and cumbersome processes for modifying flight plans and communicating the changes quickly. Operationally, the solution involves improved weather prediction and forecast distribution, more flexibility in routing, faster identification of airspace and flights impacted by weather, common availability of current information among all participants in the planning process, and procedures and training to support the collaborative adjustment of routes to ensure safety while maintaining traffic flows. A program of training for controllers, pilots, and airline dispatchers has been instituted to prepare for the severe weather season of spring/summer 2001. Annual reviews of what works and what needs to be adjusted in the collaborative process will lead to continuing refinements each year.

Key Dates

Operational Rules and Process Changes (Annual Cycle) 2002
Train Personnel and Implement Recommendations (Annual Cycle) 2002

EW-2 Solution Set

Timely identification of en route impacts, improved route predictability, and improved route flexibility through alternative route options.

Background

Today's route management remains relatively inflexible due to rigid airspace design, continued use of ground based Navaids, and incompatible databases and automation systems between users flight plan systems, FAA HOST requirements, and aircraft navigation systems. Flight plan route changes are workload intensive for all stakeholders resulting in increased flight delays, and cancellations. Advanced aircraft navigation systems have remained largely unused due to an inflexible airspace structure. Poor communication of route and airspace status continues to plague the system resulting in inefficient use of available resources. Additionally, the inability to communicate flight plan changes quickly and in bulk for major traffic flows also slows the process.

Ops Change Description

Operationally, route management will become a simplified task for all stakeholders. Common identification of impacted airspace utilizing tools such as the Collaborative Convective Forecast Product (CCFP) and the Traffic Situation Display (TSD) functions such as the Flow Evaluation Area (FEA)/Flow Constraint Area (FCA) will aid in applying solutions. The common situational awareness created though shared information will allow system users to identify their own solutions. Activating alternative route options utilizing the National Playbook or Coded Departure Routes ensure a quick implementation of a solution. The development of alternative routes including area navigation (RNAV), low altitude routes, and use of available military airspace will make airspace available during situations where normal routes are congested or impassable due to weather conditions.

Route management should be a collaborative effort between the FAA and users to ensure safety of flight (relative to fuel, hazardous weather, etc.) as well as to ensure that traffic volume and complexity concerns are considered to ensure safe separation of aircraft from aircraft.

Benefit, Performance and Metrics [suggested data sources]

- Improved predictability in delay, cancellation, and en-route time calculations [Aviation System Performance Metrics (ASPM)]
- Increase on-time departure and arrival goals. [Department of Transportation statistics, ASPM]
- Reduction of Mile In Trail due to efficient use of available airspace resources. [ATCSCC logs]
- Decrease in block times [ASPM]

- Reduction in variance of execution against plan. [POET]
- Reduce fuel consumption due to extended rerouting options which maximize throughput in area closet to the Users Preferred Trajectory (UPT) [airlines flight plan data, POET]
- Reduction in flight diversions due to extensive re-route only options. [ATCSCC diversion data]

Scope and Applicability

The roles and responsibilities for route management were a key element in the S2K +1 field-training package. The coordination efforts of the past year along with expanded options and additional airspace for conducting rerouting enhanced the ability to respond to hazardous weather. The community's plan for the 2002 severe weather season builds on these successes.

Near-Term:

- Collaboration for identifying airspace constraints, and routing solutions utilizing DSS tools such as the Flow Evaluation Area (FEA)/Flow Constraint Area (FCA) functions of the TSD and the user access through the Common Constraint Situation Display (CCSD).
  - Integrated testing of proposed FEA/FCA procedures 8/01.
  - CCSD/FCA human in the loop testing complete 11/01
  - FCA procedures and training of the Severe weather unit is planned in 2002
- S2K +1 strategic planning process,
  - A variety of information including route status, playbook initiatives, advisory sequences and task assignments were tracked and coordinated using the electronic whiteboard.
  - In 2002 a standardized format for use of the electronic whiteboard in coordinating and communicating the strategy will be developed.
- Efficient access to Canadian and Military airspace.
  - Letter of Agreements and procedures implemented for more efficient access to military airspace (5/01).
  - Agreement with NavCanada concluded to allow greater access to Canadian airspace (Spring 2001).
  - Four additional RNAV routes are under development with NAV Canada.
- Playbook:

  Continued use and development of the Playbook for expanded options.
  - FAA Notice 7210.517, National Playbook (effective 12/18/01), establishes the procedures, responsibilities, process, and cycle for the National Playbook. The process follows the standard 56-day publication cycle.

- Updates and enhancements are published on the standard 56-day cycle.
- A total of 126 plays are included in the National Playbook (11/01).
- The Playbook will be incorporated in ETMS version 7.4 (3/02)

- RMT/CDR:

  Coded Departure Routes (CDRs) provide options for departure that re pre-coordinated and pre-defined so that user and FAA systems can accept them with little or no modification.

  - FAA Notice 7210.507, Coded Departure Routes (effective 6/15/01), establishes procedures, responsibilities, process, and cycle.
  - The process follows the standard 56-day publication cycle.
  - More than 13,000 CDR's are available for use (12/01).

- Altitude Options:

  The Low Altitude Arrival and Departure Routing (LAADR) program provides options for use of low altitude routes in situations where their normal routes at higher altitudes are unavailable.

  - Dynamic use of altitude CAPing
  - LAADR agreement established between ZMP and NWA (5/01)

- Define local procedures for route management in the terminal domains utilizing tools such as Traffic Management Advisor (TMA).
  - Handbook changes have been developed with anticipated February 2002 effective date.

- Reroute communication methods:

  Establish system wide procedures for coordinating and communicating re-route strategies both in the strategic and tactical environments. Use of the Traffic Management National Log for internal ATS communication, machine-readable ATCSCC advisory formatting for system wide dissemination, and additions to the ATCSCC web site (e.g., the diversion recovery page), will enhance all communication.

  - TMNL deployed at 7 beta sites (9/5/01).
  - TMNL Version 1.22, Enhancements to the viability of the restriction process (scheduled 2/02)
  - TMNL expansion to most ARTCC's planned for Spring 2002
  - Collaborative Decision-Making (CDM), Collaborative routing (CR), Reroute Advisory Team (RAT) has been established to identify requirements for machine-readable advisories. Human in the loop testing conducted July-October 2001. Product was enhanced based on recommendations of the group.
    - Phase I implementation scheduled for 3/02.

- Phase II implementation scheduled for 10/02.

- Additional use of area navigation (RNAV) for departures, en-route and arrival routes.
  - Handbook changes are in development, anticipated to be effective in August 2002.
- In 2002 the Severe Weather unit will work on a consistent process for conveying MIT associated with weather reroutes

Mid- to Long- Term:

- Use of U.S. domestic reduced vertical separation minima (RVSM) to reduce the need for reroutes where projected congestion is the cause.
  - Possible limited tactical use 7/03
  - National implementation planned for 12/04
- Improved communication of route status.
  - CRCT functionality
  - Initial routing functions
  - Show “entering flights” counts in bar chart and timeline
  - Time-in-FCA display
  - Include FCA in TSD replay
- Enhanced automation for re-route solutions
- URET for ARTCC areas and controllers
- TSD FEA/FCA capabilities for TMU’s.

Key Decisions

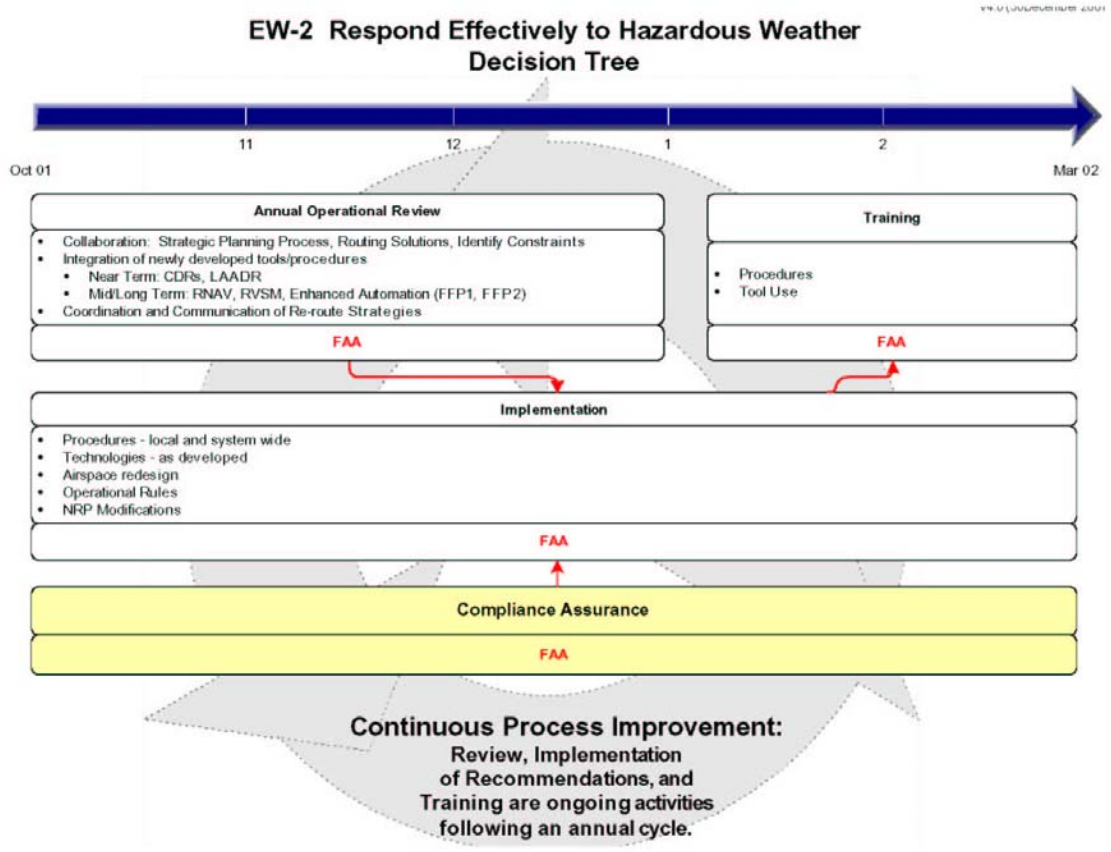
- Aircraft performance efficiencies and cost of using low altitude routes
- Cost/benefit analysis for aircraft equipage for RVSM implementation.
- Compatibility and integration of automation systems between NAS users and FAA HOST.
- How to hold users accountable for "not" allowing aircraft access to the system when needed. For example, aircraft are allowed to depart even when it is known they can't land, and then delays are counted as weather or ATC.
- Pursue local MOU's for LAADR usage.
- The Tactical Altitude Assignment Program (TAAP) is part of the National Airspace Redesign Choke Points activities.
  The community completed the TAAP trials with the result that TAAP at a national level was discontinued 06/01.
- In 2002, we will evaluate the effectiveness of CIWS as a tool for evaluating a centers request to open or close an airway for weather.

Key Risks

- Limited availability of airspace in high volume situations that often occur in the northeast during severe weather.

- Arrival and departure routing within terminal areas is limited by what can be accommodated adequately within prior environmental studies.
- Major additions to routes in terminal areas require design studies including environmental impact assessments.

EW-2 Decision Tree



EW-2 Responsible Team

Primary Office of Delivery
Jack Kies, ATT-1

Support Offices
ATA-1
AFS-400

ATP-1
AUA-400
AIR-100
AOZ
AUA-700

EW-2 Links To Architecture

Air Traffic Services / TM-Strategic Flow / Flight Day Management
105201 - Current Flight Day Management
105204 - Collaborative Rerouting (CRCT Demonstration)

Air Traffic Services / Airspace Management / Airspace Design
108101 - Current Airspace Design